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CHEMICAL & ENGINEERING

NEWS

Thermophilic Bacteria

Their enzymes may find
increasing commercial use
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News of the Week

■ Efforts to recruit and retain female, minority, and disabled students in university science and engineering programs fall short of what is needed, according to study issued last week. **Page 6**

■ This week, hundreds of chemistry-related groups all over the U.S. will bring chemistry to the public during National Chemistry Week, a huge public relations effort organized by the American Chemical Society. **Page 7**

■ French government and Rhône-Poulenc launch five-year, \$278 million biotechnology effort focusing on agriculture, chemicals, and human health. **Page 7**

■ Federal jury upholds Xoma Corp.'s patent covering use of monoclonal antibodies for treatment of sepsis bacterial infections, and finds that competitor Centocor is infringing the patent. **Page 8**

Cover: Hydrothermal vent in Pacific Ocean is typical of sites where thermophilic bacteria have been found. Photo by Holger W. Jannasch, Woods Hole Oceanographic Institution

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Business

Chemical industry growth in Europe is stunted by depressed economy, forcing companies to adopt hard measures; Asia is becoming self-sufficient in petrochemicals; Australian chemical industry embattled by economy, chemophobia, other pressures, maintains long-range optimism; small firm, Genus, bets on its technology for using chemical vapor deposition in electronics applications. **Page 13**

Government

Toxic Release Inventory spawns new laws that increase demands on chemical industry in its reporting of chemical emissions; Congress approves 10% increase for research funding as it struggles to approve appropriations bills for 1992 budget; Bush expected to press Japanese for about \$1 billion for Superconducting Super Collider project; scientists assail proposed changes to federal ethics rules, especially attacking rule regarding participation in professional associations. **Page 24**

Science/Technology

BP Chemicals to license its new maleic anhydride process worldwide following successful large-scale trial production; at first Manhattan Poster Project, 36 physical chemistry graduate students shared their research in progress. **Page 34**

People

Milton Harris: a successful professional career and a productive life as remembered by a long-time friend. **Page 42**

Awards

ACS award winners: Sharpless, Berson, Diederich, Dinnocenzo, Dougherty, Hilvert, Hopkins, Ingold, Lerner, Magnus, and Scott. **Page 44**



Cover Story

Bacteria that flourish above 100 °C may provide stable enzymes for catalyzing high-temperature reactions in industrial processing. **Page 31**

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LETTERS

Tax for fuel economy?

I was intrigued by an item in the Government Concentrates (C&EN, Sept. 23, page 12). A study by the economists of Charles River Associates, paid for by the automakers, concluded that adding a 27.5-cent charge per gal of fuel as a carbon dioxide tax would save more fuel than mandating a fuel efficiency (CAFE) of 40 miles per gal.

It is these types of studies that raise serious questions of credibility. Consider the logic. Instead of truly reducing real consumption and carbon dioxide emissions, we add a tax. As is well understood, most driving is not discretionary. People primarily use their cars for work and that type of driving cannot be curtailed. Thus, consumers would be forced to pay a tax, while continuing their driving habits, which would have no real effect on reducing emissions. But taking the analysis a step further, what would these consumers do? Of course, they would buy cars that get high mileage, such as those that get 40 miles per gal. Consider the effect of the shortage in 1973. The automobiles highest in demand were either the Honda Civic or the diesel Rabbit, which was rated at 50 miles per gal. Thus, the market will force the automakers to meet the CAFE limits regardless of the regulation. The net effect, of course, would be that in the interim even with 40-mile-per-gal cars, consumers would be paying an additional 27.5 cents per gal.

This study makes no sense unless one considers the automakers' objective. They do not want to be forced to meet CAFE standards. How to avoid it? Present a new tax on fuel before the government, cloaking it in the garb of being an environmental necessity. By making this a "credible" alternative, automakers can "buy" their way out of the regulation with taxpayer dollars.

The sad part of this is that it may work. With Washington starved for revenue, and the environmental cause being one of the hot buttons that our politicians wish to associate with, our legislators may accept the rationale regardless of the fact that it is counterproductive.

A Japanese manufacturer has recently introduced a new car that does, in fact, get 50 miles per gal and does so with performance and style. CAFE or no CAFE, the American automakers will continue to lose market share.

I am grateful that I am associated with the chemical industry, because regardless of the public perception, I have always found chemical industry professionals to be truly concerned about their social responsibilities and am sure those same professionals would not stoop to producing studies such as this one as a way to avoid regulations. The automakers simply have not learned that the short-term benefits to these manipulations are really no benefit at all.

William J. Sapone
New York City

Noninterview remembered

In view of the present furor aroused by the Judge Clarence Thomas hearings, you might be interested to know that 31 years ago an industrial outfit in the Boston area invited me for an interview for a position as a chemist.

When I appeared, the interviewing chemist shook my hand, looked at me in silence for 10 seconds, and said, "Good-bye Dr. Gleiser." As soon as I reached home—boiling mad—I called him and asked him the meaning of my noninterview. He replied, "I just wanted to see what a 90-pound female Ph.D. chemist looked like."

I have long since forgotten this gentleman's name. But perhaps he would like to stand up now and take a bow.

Molly Gleiser
Berkeley, Calif.

Appointment in Samarra

You had a story on the visit of United Nations inspectors to Iraq's largest chemical weapons facility at Samarra (C&EN, Aug. 5, page 5). Apparently, the UN team has an appointment to return for a further inspection in September.

It is curious that a facility dealing in death should be located in this ancient city, the scene of a well-known Arab tale of the inexorability of fate: A servant in Baghdad saw Death in the marketplace, personified by a woman who made a menacing gesture. Frightened, he borrowed his master's horse and rode as fast as he could to Samarra to escape his fate. Later, the master saw Death in the marketplace and asked why she had threatened his servant. She answered, "I didn't threaten him. I was simply aston-

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Depressed European Economy Mires Chemical Industry Growth

But overcapacity will be averted as mature business with too many companies is forced to adopt hard measures, cut back expansion

It didn't take too many market-research crystal balls to give the obvious answer: The European chemical industry is mirroring the state of the European economy, whether in Western or Eastern Europe or the Soviet Union.

The West European economy has undergone "substantial change" in the past 18 months, noted Richard Freeman, corporate chief economist at ICI, at the recent meeting of ECMRA, the European marketing research group, in London. "After several years of strong growth, real gross domestic product (GDP) in many countries slowed down sharply around mid-1990, and the slowdown gathered pace in the first half of this year."

There are some glimmers of hope, however. "With the main exception of Germany," he said, "demand and activity in Europe now seem to be strengthening again, although the recovery will be rather weak and drawn out."

Western Europe's average GDP was growing at more than 4.5% per year in 1987. By 1990, however, that growth dropped to 2.8%, and this year is expected to decline further to only 1.4% over last year. General economic growth in 1992 is forecast to be only a little over 2% over 1991.

Meanwhile, in Eastern Europe the economies are even more depressed, and output is expected to continue to fall for the next two or three years at least.

In a way, that may help the European chemical industry. Too much growth could overstimulate capacity additions, according to Peter Vogtländer, chemicals coordinator for Shell International Chemical Co.

The scars from the massive cut-backs in the industry in the early 1980s may still be felt by now senior executives, he said, but "we are seeing a repetition of the early 1980s. For a mature business, there are too many players; we see some new players coming in as well. The industry will have to sort itself out."

One potential answer, he suggested, is that a number of firms that had been holding on from 1987 to 1989 because they were making money, not because the businesses were "core," will now swap portfolios, or go out of these businesses altogether.

"Companies will be forced to cut back expansion plans," Vogtländer predicted. "Do chemical companies want to have a lot of blood on the table? That doesn't get them anywhere. They will have to make decisions. The senior people in the companies now lived through the miseries of the early 1980s. Now people are willing to take harsh measures, earlier. I don't think the senior people will have the same optimism as they had in the 1980s, that things will get right in a few months."

He touched on the opening up of Eastern Europe: "The opportunities and risks [for Western European producers] will be tremendous. Forecasts seem to include the positive impact on demand from these countries, but seem to ignore the potential impact on supply. Isn't it logical and prudent to assume that not all of the extra demand for petrochemicals in this part of the world will be imported from the West and that, in many of the East European countries, plants will be built?"

Soviet output of polymers has risen, but trails demand

	% change 1985-90	Production as % of demand
Polyethylene	3%	57%
Polypropylene	37	55
Polystyrene	12	60
Polyvinyl chloride	46	65
Synthetic fibers	6	86
Synthetic rubber	-3	93

Source: Moscow Institute of Applied Biotechnology

However, for a significant period in the future, there will still be ample opportunity for western companies to supply the Eastern European markets, said Vladimir Vakula, professor at the Moscow Institute of Applied Biotechnology.

"When the Iron Curtain disappeared, a new curtain appeared—currency," he said. "It is very effective, although not as dense as the other." This has been one of the main reasons for a changing and deteriorating situation in the Soviet chemical industry over the past two years and into the first half of 1991.

As in Western Europe, the chemical industry has mirrored the parlous state of the general economy. According to Vakula, in the first half of this year, the Soviet gross national product (GNP) has fallen 10% and productivity 11% from first-half 1990. In June 1991, industrial production was down 9% from June 1990, with drops for 127 out of 156 products for which official statistics are collected.

One of the reasons for the continuing economic problems, he said, remains the militarization of the national economy—25% of GNP is accounted for by military expenditures, and in the engineering sector, 80% of production is assigned to military.

"Industry works for its own sake, rather than for the customer's needs," said Vakula, with only 25% of GNP going into consumer goods.

Cooperation between supplier and customer is almost nonexistent, and is not considered important, he noted. In fact, in 1989, one half of all supply contracts were not fulfilled.

According to Vakula, in the years from 1985 to 1990, there was a continuing rise in the growth rate for production. But year to year, the rate has been falling. Many products don't come close to meeting domestic demand, although capacity utilization is relatively high. However, outmoded plants and equipment have hindered production expansion, and the country has not kept up in its bid to modernize. Only about 60% of planned capital spending for the five-year period was actually spent.

There are many incentives, he believes, for western companies to invest. First, the Soviet chemical industry is the third largest in the world, "and it is still functioning." "The share of chemicals is only 6.3% of total industrial production, and it should be 10 to 12%." Another major plus is the country's serious R&D potential; it has more than 100 research institutes, with 100,000 employees, as well as the Soviet Academy of Sciences and the institutes of higher education.

"The U.S.S.R. suffers from a shortage in all products the chemical industry supplies. Hence, western investors targeting construction of production units or plants do not have to be worried about competition for at least the next five to 10 years," he added.

Patricia Layman

Asia becoming self-sufficient in petrochemicals

Because of the high growth rate of Asian industry, the global petrochemical industry has become tripolar in demand, centered in the U.S., Europe, and now Asia. To meet that demand, the production picture is changing, too: The Asian region, once a large net importer of petrochemicals, is gradually becoming self-sufficient.

Yoshio Tokuhisa, managing director for strategic and corporate planning at Mitsubishi Petrochemical Co. in Tokyo, drew that picture of the Asian chemical industry at the recent meeting of the European marketing research group ECMRA in London. But he pointed out that production in Japan and in Southeast Asia is increasing so rapidly that many industry observers are concerned that the region is embarking on the same kind of overbuilding that occurred in Western Europe in the late 1970s in basic petrochemicals. The result, lasting into the mid-1980s, was a glut of product and abysmal operating and profit figures.

Not all the Japanese ethylene projects that have been proposed will be built, he predicted. "I think there is a high possibility that we in Japan can avoid extreme excess capacity. We are not terribly happy, but the situation is bearable."

However, there is a major likelihood of Asian overcapacity because of projects under way or proposed in South Korea. "The thought of the Korean petrochemical industry raises my blood pressure and gives me a headache," says Tokuhisa.

Since a substantial amount of South Korean products are likely to be exported, the negative impact on the global, particularly the Asian, petrochemical industry will be enormous, Tokuhisa explained. Japan will be particularly hard-hit, especially in the short-term, with a decrease of up to 2% on profit margins—an annual loss of \$400 million to \$600 million in profits from the whole Japanese petrochemical industry—and a loss of some of the country's existing markets in Korea and China.

However, the impact will be diluted after that, as world growth in demand absorbs the production.

One of Tokuhisa's concerns is the significant forward- and backward-integration in the South Korean petrochemicals business. Derivative producers who used to purchase ethylene are now producing, and ethylene producers are also moving into derivatives production. "This combination has led to... enormous excess capacity," he said.

In 1988, South Korean ethylene

capacity was 500,000 metric tons per year, and by 1993 it is expected to hit 3.2 million—more than six times that in 1988. By contrast, in Western Europe, ethylene capacity in 1993 is expected to be 1.2 times that in 1988, in the U.S. 1.3 times, and in Japan 1.4 times.

"On top of this, some large group companies with almost no experience in the petrochemical industry are also entering the business, constructing both upstream and downstream facilities concurrently," Tokuhisa notes. Key examples are Samsung and Hyundai, which are each building 350,000 metric ton-per-year ethylene crackers, to be finished by the end of this year. "It is like Sony Petrochemical and Toyota Petrochemical being established at the same time," he adds.

By Mitsubishi's calculations, profits for all the South Korean industrial groups—shipbuilding, watches, electronics, and so on—will be almost exactly offset by their losses in petrochemicals. This factor led Tokuhisa to predict that the South Korean government would be forced to step in with rescue aid.

That kind of overcapacity inevitably signals a price war spreading throughout western markets, Tokuhisa said, as Korean products seek purchasers. "They will export to the U.S., probably not to Europe or the Middle East. A price war is already starting to happen," he added. "Japanese prices are relatively high, and Korean producers are trying to enter our market, but they are finding it very difficult. So they are trying to enter other Southeast Asian countries, or the U.S."

Besides the Korean projects, others have been announced in the Asian region. Among them: two in Taiwan, for a total of 850,000 metric tons per year; one in China, at 380,000 metric tons; a second cracker in Thailand, with 350,000 metric tons; cracking capacity in Indonesia of 550,000 metric tons; and a cracker in Malaysia, with 320,000 metric tons. That's a total of 2.45 million metric tons per year of announced capacity, most to be operating in 1994-95.

"Even if we assume that only half of them will materialize, the impact will still be enormous," Tokuhisa said.

Tokuhisa did not include another capacity addition, in Singapore. But according to Siau-Chua Lim, the U.K. director for the Singapore Economic Development Board, Singapore is encouraging projects at the high-value-added end of the petrochemical chain, to get away from too much economic reliance on basics.

All told, the Singapore chemical industry had sales of \$9.9 billion in 1990, Lim said, giving a brief description of the industry: 175 international and local companies in this sector, employing 13,000 people, and growing at an average of 15% per year from 1975 to 1990. It is the second largest manufacturing sector there, accounting for 25% of total manufacturing output, after electrical equipment.

The country's refining industry accounts for about 10% of the total primary refining capacity in Asia, and has evolved to be what Lim calls the swing refining center in Asia.

"The strong refining base led us to the petrochemical industry in the early 1980s. The Singapore petrochemical complex was the first in Southeast Asia, costing then \$1 billion," he said. The project was a joint venture between the Singapore government, which has since sold most of its share to Shell, and a consortium of mostly Japanese companies, led by Sumitomo Chemicals. The complex uses both naphtha and liquefied petroleum gas as feedstock, to produce 400,000 metric tons per year of ethylene, 200,000 of propylene, and 150,000 of benzene, toluene, and xylenes.

Monomers are fed to seven downstream companies, producing linear low-density polyethylene, high-density polyethylene, polypropylene, ethylene oxide and ethylene glycol, ethoxylates, methyl-methacrylate butadiene styrene, methyl *tert*-butyl ether, and acetylene black.

"At the time the project was conceived, there were great uncertainties about the world economy, and the petrochemical industry in America and Europe was in disarray and under major restructuring," Lim pointed out. "But my government thought the strategic factors for the project were sound. ... The initial years were indeed difficult. The market turned around in the mid-1980s, and

the complex became quite profitable from then on."

There are now plans to expand the complex, noted Lim. "The output of the sector reached \$1 billion last year—not a bad achievement, considering that the industry was virtually nonexistent 10 years ago." Since its startup in 1984, the petrochemical complex has expanded to its limit through debottlenecking

and more downstream projects, he noted, and there are preliminary plans to double the capacity.

Expansion is expected to be completed in 1995, and will cost \$1.5 billion. Besides more petrochemicals, it will also add new derivatives capacity. For example, it will include engineering plastics and specialty fibers and aromatics and oxo-chemicals.

Patricia Layman

Australian chemical industry battling adversities

This year has been characterized as a "doom year" for Australian chemical manufacturers. But as bad as things look now, there is still long-range optimism, fueled by a hardiness that seems as native to Australia as the outback.

Richard Warburton, vice president of the Australian Chemical Industry Council (ACIC) and managing director of Du Pont (Australia), observes that in 1989 profits dropped 30% and sales dropped 15%. Performance was equally bad in 1990, and few signs have emerged that matters will get any better very soon. The most negative effects may be decreased attractiveness for investment in high-technology and value-added industry.

Investment in new plants has fallen off during the past two years. The primary reason, Warburton says, is persistent overcapacity. To compound the problems, capital costs in Australia are among the highest in the world and chemical imports have doubled during past five years. Probably the most prominent problem is a wave of extreme chemophobia that has swept over Australia. Despite demonstrated high safety standards and compliance, the Australian chemical industry does not presently enjoy popular acceptance.

The government may not be helping the situation. According to Frank V. Phillips, chief executive officer of ACIC, last spring the Australian government issued an industry statement that had some negative effects. Phillips says tariff reductions combined with a failure to deliver on some basic economic reforms have done little to buoy the spirits of the industry. The maximum tariffs for chemical imports will drop from 15% to 5% in the next few years. Before 1987 tariffs were as high as 45%.

Phillips and ACIC suggest that some of the needed reforms are a more modern infrastructure, espe-

Australian chemical industry: its 1990 performance ...

	\$ Millions (U.S.)	% change from 1989
Sales	\$ 3,630	-9.3%
Trading profits	330	-46
After-tax profits	132	-59
Exports	413	8.4
Imports	2,560	—
R&D expenditures	40.3	3.3
Environmental protection expenditures	46.3	1.8
Employment	11,175	-8.1
Operating capacity	88.2%	-2.3

... and its plans for expansion

\$ Millions (U.S.)	Committed projects		Possible additions	
	1 year	3 years	1 year	3 years
New plants ^a	\$231.4	\$451.2	\$27.3	\$238.0
Improvements in existing plants ^a	124.8	292.6	10.7	54.5
TOTAL	\$356.2	\$743.8	\$38.0	\$292.5

Note: Dollar amount based on \$1.00 U.S. = \$1.21 Australian. ^a Data for basic industrial chemicals and synthetic resins; fertilizer manufacture is excluded. Source: Australian Chemical Industry Council

cially with respect to waterfront and coastal shipping; better land transport; and more enlightened labor policies. A particularly strong recommendation is for a more broadly based consumption tax.

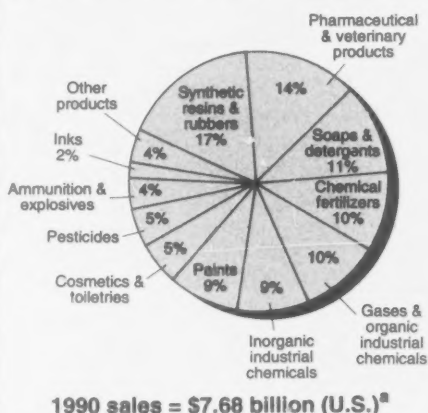
Among the positive features of the government's industry statement were the removal of Singapore, Taiwan, Hong Kong, and South Korea from preferred trading status and an improvement in depreciation allowances. The government has also decreased to a maximum of 40 days the time required to rule on dumping actions. Environmental impact statement expenditures have been made tax deductible, and the deduction for R&D expenses will remain at 125% at least until 1993.

A problem that has grown serious since 1989 is the training of personnel for the chemical industry. A bewildering maze of national and state training offices may be sometimes purely advisory and sometimes more authoritative. Consequently, conflicting recommendations can ensue, and the industry keeps a close watch to ensure that "the training agenda of these agencies is not dominated by the bureaucracy."

The matter of training is closely tied to the wage-realization structure. In the state of Victoria, for example, a certificate in chemical plant operations-chemical processes, obtained from an approved course of instruction, affects future pay classification. Similarly at the national level, certified instruction in chemical plant operation is under development by the colleges. At the end of 1991 the certification procedure from Victoria is supposed to be merged into the national procedure, but this may not eliminate the bureaucratic confusion.

If training professional personnel to operate the chemical industry is a major problem, even more vexing is educating the public to view the chemical industry from a more realistic perspective. A current drive by the industry to gain public understanding is typified by the Responsible Care program being managed by ACIC, which represents about 95% of the Australian chemical makers.

Australian chemical industry sales break down this way



1990 sales = \$7.68 billion (U.S.)^a

^a Based on \$1.00 U.S. = \$1.21 Australian.
Source: Australian Bureau of Statistics

These chemical makers directly employ about 10,000 people and, indirectly, about double that number.

ACIC's Responsible Care, like the Chemical Manufacturers Association's Responsible Care program in the U.S., was adapted from a similar program begun by the Canadian Chemical Producers Association in the mid-1980s. It began in Australia in late 1989 and is scheduled to be completely implemented by 1993. The objective is to demonstrate responsible operation of plant facilities in compliance with regulations and good practice and to improve operation where possible. This is to be done with the cooperation of and in full view of the public. In fact, the industry has been doing exactly this for some time, but the public's chemophobic attitude requires more dramatic measures to prove it.

In the spring of 1992, ACIC will conduct its third Industry Open Door. About 40 major chemical plants will host 40,000 visitors and explain the operations to anyone with questions and interests. The immediate purpose is to "demystify" the view of the industry often held by the visitors and to demonstrate the industry's importance. Ideally the Open Door will also help promote potential careers in the industry by interested young people. Previous Open Doors were held in 1987 and 1989.

Much of the chemophobia in Australia is attributed by industry leaders to Greenpeace activists and similar groups. According to a number of industry spokesmen, the "misinformation" of these groups has been disseminated by "largely uncritical media." A celebrated incident occurred in May 1990, when Greenpeace attempted to block a discharge pipe from Nufarm Co., a pesticide maker near Melbourne. According to ACIC's Phillips, in a letter to *Chemistry in Australia*, Greenpeace claimed that the discharge contained dioxin levels 100 million times higher than U.S. safety standards. These levels, claimed Greenpeace, represented the most serious toxic-waste problem the environmental organization had encountered in Australia. Subsequent media publicity shed little light, but emotions were inflamed.

Eventually the discharge was thoroughly tested by independent analysts and declared not to be a hazard. Similar views then were voiced by several investigative reporters. The Melbourne Metropolitan Board of Works also issued a statement that Greenpeace had misled the public. It seemed that Greenpeace had been thoroughly discredited in this episode. However, Greenpeace responded further with the claim that the Board of Works had continued to ignore the contamination levels and that some chemical companies—for example, Monsanto and BASF—had fabricated basic data on the dioxins that are often cited in regulatory proceedings.

Chemical industry executives in Australia give the impression that the industry is embattled but hardly ready to capitulate to economic pressures or environmental activist opponents.

A perennial problem for the Australian chemical industry is foreign ownership. Most of the major chemical companies are based in Europe, Japan, or the U.S. That offers much-needed capital acquisition for a market of about 17 million people, but it also tends to severely limit the very high potential for home-grown research and development that could improve Australia's export position.

Joseph Haggis

R&D funds up 10% in 1992 appropriations bills

It's become an annual rite of autumn. Federal agencies operating under a continuing resolution because as of Oct. 1, the mark of the new fiscal year, Congress had not completed work on the 13 appropriations bills needed to keep the government in funds. At press time the majority of the bills were on their way to the White House for signing. But the two that provide money for the largest research-sponsoring agencies—the departments of Defense and of Health & Human Services—were lagging far behind their counterparts.

So far research funding has fared better than might have been expected in the first year under the binding budget agreement worked out late last year between the Administration and Congress. That agreement allowed overall funding for domestic programs to grow enough to recover buying power lost to inflation, which is currently running at about 2%. However, Congress has approved an overall increase of 10%, to \$17.4 billion, for the six research-sponsoring agencies whose fiscal 1992 budgets are now in place.

In many cases, Congress increased research funding, but by less than the Administration wanted. The National Aeronautics & Space Administration's research budget is a case in point. It's up 6% to \$6.4 billion, still ahead of inflation, but the Administration was looking for a 20% increase to \$7.2 billion. Congress did provide the full budget request of \$2 billion for the space station program and capped fiscal 1993 funding for the program at \$2.3 billion.

Overall funding for the National Science Foundation is also up 11% to \$2.6 billion. However, Congress once again rebuffed the Administration's plan, which first surfaced during former President Reagan's term, to double funding for NSF research programs over five years. Research and related programs are up 11% to \$1.9 billion, compared with the 16% increase the Administration had sought. However, it got more than the 21% increase it wanted for NSF's education and human resource activities, with Congress' approval of a whopping 44% increase to \$465 million for those programs.

The Department of Energy fared better than either NASA or NSF. Overall funding for its research programs is up 14% to \$4.3 billion. However, funding for basic energy sciences is up only 7% to \$765 million, with funding for chemical sciences frozen at \$158 million and that for materials sciences down 6% to \$257 million.

Energy's fiscal 1992 R&D budget, as usual, presented a particular target of opportunity for another annual ritual—earmarking research funds for specific projects, many with no apparent connection to the work of the agency that is providing the funding. For example, out of the department's energy supply R&D budget Congress set aside funding for these projects:

- \$10 million for the Institute of

Energy R&D, NSF education programs fare well as Congress approves 1992 budgets

\$ Millions	1992		1991	% difference Appropriation- request	% change 1991-92
	Appropriation	Request			
NASA R&D	\$ 6,413.8	\$ 7,198.5	\$ 6,023.6	-11%	6%
Energy	6,177.4	5,783.4	5,447.1	7	13
Energy R&D	4,251.2	4,031.2	3,717.3	5	14
General science and research	1,472.5	1,548.9	1,148.7	-5	28
Basic energy sciences	764.7	714.7	711.7	7	7
Materials sciences	257.1	257.1	274.9	0	-6
Chemical sciences	158.3	158.3	157.6	0	0
Fossil	450.1	227.0	458.8	98	-2
Environment	353.3	312.6	393.9	13	-10
Fusion	337.1	337.1	273.6	0	23
Nuclear	332.0	398.0	304.0	-17	9
Conservation	299.8	290.9	228.3	3	31
Solar, other renewables	241.7	202.1	198.3	19	22
Defense R&D	1,926.2	1,752.2	1,729.8	10	11
Weapons	1,231.0	1,074.0	1,077.8	14	14
Naval reactor development	695.2	678.2	652.0	2	7
NSF	2,574.0	2,718.5	2,313.0	-5	11
Research and related activities	1,879.0	1,963.5	1,694.2	-4	11
Education and human resource activities	465.0	390.0	322.3	19	44
Antarctic activities	88.0	193.0	175.0	-54	-50
Salaries and expenses	109.0	122.0	101.0	-11	8
Academic research facilities and instrumentation	33.0	50.0 ^a	20.5 ^b	-34	61
USDA	1,397.8	1,279.1	1,281.6	9	9
Agricultural Research Service	658.4	660.6	621.6	0	6
Cooperative State Research Service	430.7	384.2	388.5	12	11
Forest Service research	182.8	163.2	167.6	12	9
Building and facilities	125.9	71.1	103.9	77	21
Commerce	544.4	529.3	513.0	3	6
Oceanic and atmospheric research	209.3	187.0	206.7	12	1
NIST ^c	246.7	248.0	215.3	-1	15
PTO ^d	88.4	94.3	91.0	-6	-3
EPA R&D^e	323.0	313.0	254.9	3	27
TOTAL	\$17,430.4	\$17,821.8	\$15,833.2	-2%	10%

^a Money requested for facilities only. ^b Funds appropriated for instrumentation. ^c National Institutes of Standards & Technology. ^d Patent & Trademark Office. ^e Does not include intramural research funds. Source: Appropriations Committees' reports.

Micromanufacturing at Louisiana Tech University, Ruston.

- \$10 million for an ambulatory research and education building at the Oregon Health Science University, Portland.

- \$10 million to expand the Energy, Mineral & Materials Science Research Building at the University of Alabama, Tuscaloosa.

- \$10 million for construction of a research institute at California's Loma Linda University Medical Center.

- \$10 million for construction of a cancer research center at Indiana University School of Medicine, Indianapolis.

- \$10 million for construction of the Old Colony Center for Technological Applications at Bridgewater State College in Massachusetts.

- \$10 million for the Center for Molecular Electronics at the University of Missouri, St. Louis.

- \$6 million to complete the Biomedical Research Institute for Louisiana State University's Medical Center in Shreveport.

- \$4.8 million for the Medical University of South Carolina's Cancer-Oncology Center.

- \$4 million for the Technology Complex at Pittsburg State University in Kansas.

Janice Long

Japan ponders support for U.S. supercollider

President Bush is expected to press for Japanese support for the Superconducting Super Collider (SSC) when he meets with the new Japanese Prime Minister, Kiichi Miyazawa later this month.

Bush won't have an easy time of it, however, because Japanese sources say Miyazawa will be asking Bush some tough questions about just why the U.S. thinks the controversial machine is all that important for science and for relations between the U.S. and Japan—especially in light of significant sentiment in Congress to kill it.

The question of Japanese support for the big collider serves to highlight many of the trade, investment, and attitudinal strains between the two countries. "Miyazawa will have to convince a lot of his ministers that the collider is important for overall relations between Japan and the U.S.," says one source. "There will be some hard bargaining" over other areas of cooperation, such as in education and technology transfer, says the source. Adding to Miyazawa's difficulties will be new Japanese resistance to U.S. demands that it change its ways.

Although the original cost of the 40 trillion eV accelerator was put at \$5.5 billion when the Administration first announced plans to build it in 1987, current estimates now run to about \$10 billion. Last year, the Department of Energy asked Japan for \$2 billion in SSC support, but

that request has been scaled down to something from \$600 million to \$1 billion over five years or so in the form of direct grants, equipment contributions, construction assistance, superconducting magnet development, and instrumentation.

Japan has resisted participation for two predominant reasons. One, it was never promised any kind of role in planning and administering the project, and two, it has its own scientific needs to meet in a domestic science budget that is perpetually tight. The infrastructure of Japan's universities is considered among the worst in the industrialized world, and for Japan to take its place as a major global contributor to basic research, the

universities need a massive infusion of capital. SSC support, Japan's academic leaders fear, would seriously cut into the help they are hoping to get from the new Miyazawa government. Miyazawa already has been told that a special fund for the SSC will have to be set up before Japan's science community consents to SSC support.

Last month, Bush's science adviser, D. Allan Bromley, outlined a series of concessions to the Japanese in hopes of breaking down their resistance. He told Japan's Science Council he was offering Japan an "equity position in the construction and operation of the SSC" whereby Japan would be involved in the SSC's planning, construction, and management. "This proposal," he said, "marks a new approach to the construction and operation of a major international science project. We need your country as a partner if this is to occur."

Bromley also suggested the Japanese approach supporting the SSC in the same way the U.S. did: Tie it to increasing funds for academic basic research. Combining the two, said Bromley, would bring Japan's science to the international level of its technology.

Bromley embellished his plea with offers to support current Japanese thrusts in international science and technology projects. One such initiative is the Human Frontiers Science Program, which funds international research in basic biology, a

